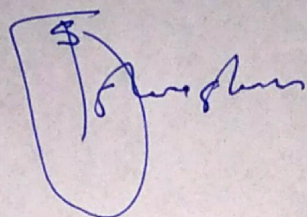


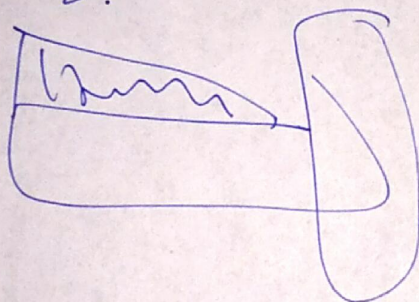
Daniel Kenneth Villanueva
1838779

EN6MEC3 Final Exam

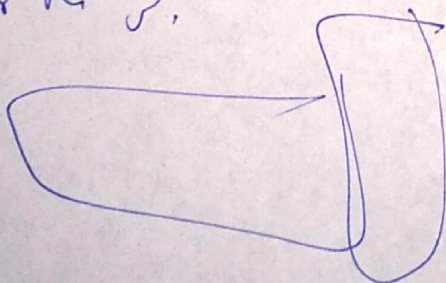
Question 1:



Question 2:



Question 3:



Question 4:

$$\sigma = \frac{F}{A}$$

$$4.5 \text{ MN/m}^2 = 4.5 \text{ N/mm}^2$$

$$\sigma = \frac{1.5 \text{ N/mm}^2 (500 \text{ mm})}{4 (20 \text{ mm})} = 18.75 \text{ MPa}$$

Question 5:

$$\sigma = \frac{pD}{4t} \Rightarrow 12 = \frac{(0.3) \left(\frac{180000}{4.5 \times 10^3} \right)}{4(t)}$$

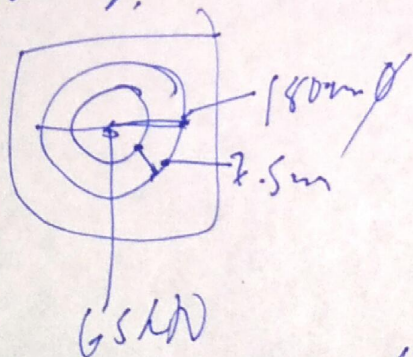
$$t = \frac{0.3(3000)}{4(12)} = 18.75 \text{ mm}$$

Question 6:

$$\sigma = \frac{pD}{4t} \Rightarrow 56.25 = \frac{p(1500)}{4(5)}$$

$$p = 0.75 \text{ MPa} < 250 \text{ kPa}$$

Question 7:

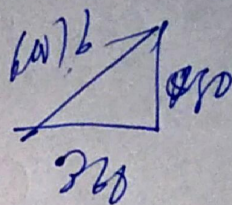
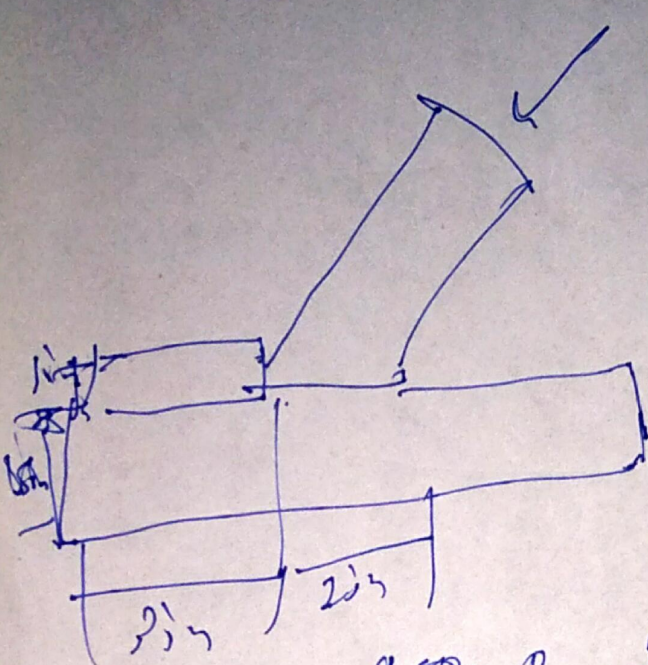


$$\sigma_{\text{max}} = 1.35 \text{ MPa}$$

$$A = \pi \left(\frac{180}{2} \right)^2 - \pi \left(\frac{7.5}{2} \right)^2 = 4068.44 \text{ mm}^2$$

$$\sigma_b = \frac{65000}{4068.44} = 15.95 \text{ MPa}$$

Question 8:



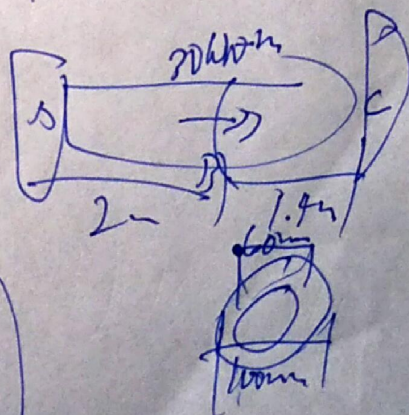
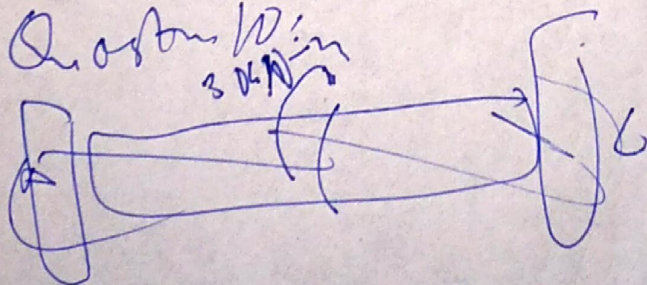
$$\sigma = \frac{480}{(2)(1.5)} = \boxed{160 \text{ psi}}$$

Question 9:

As Question 7:

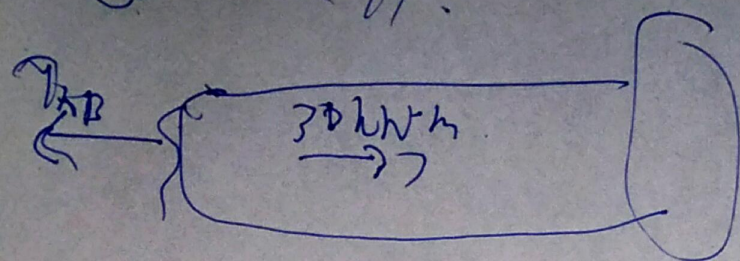
$$\sigma_b = \frac{68000}{4064.44} = \boxed{16.59 \text{ MPa}}$$

Question 10:



$$T_2 = T_B, \theta_{LP} \neq \theta_{R2}$$

Question 11:



$$T_{AB} = 30 \text{ kN/m} \cdot r(T) = 30 \times 10^3 \text{ N/m} \cdot r(T)$$

~~Question 12:~~

$$T_{AB} = \frac{T_{AB, \text{rad}}}{J_{AB}}$$

$$J_{AB} = \frac{\pi D^4}{32} = \frac{\pi (100)^4}{32} = 9.82 \times 10^6 \text{ mm}^4$$

$$T_{AB} = \frac{20 \times 10^6 \left(\frac{100}{2} \right)}{9.82 \times 10^6} \leq \boxed{152.75 \text{ MPa}}$$

~~Question 12:~~

$$\cancel{\sigma_{pr} = \frac{\pi D^4}{32} = \frac{\pi (100 - 60)^4}{32} = 251327.4 \text{ mm}^4}$$

Answer ~~is~~!

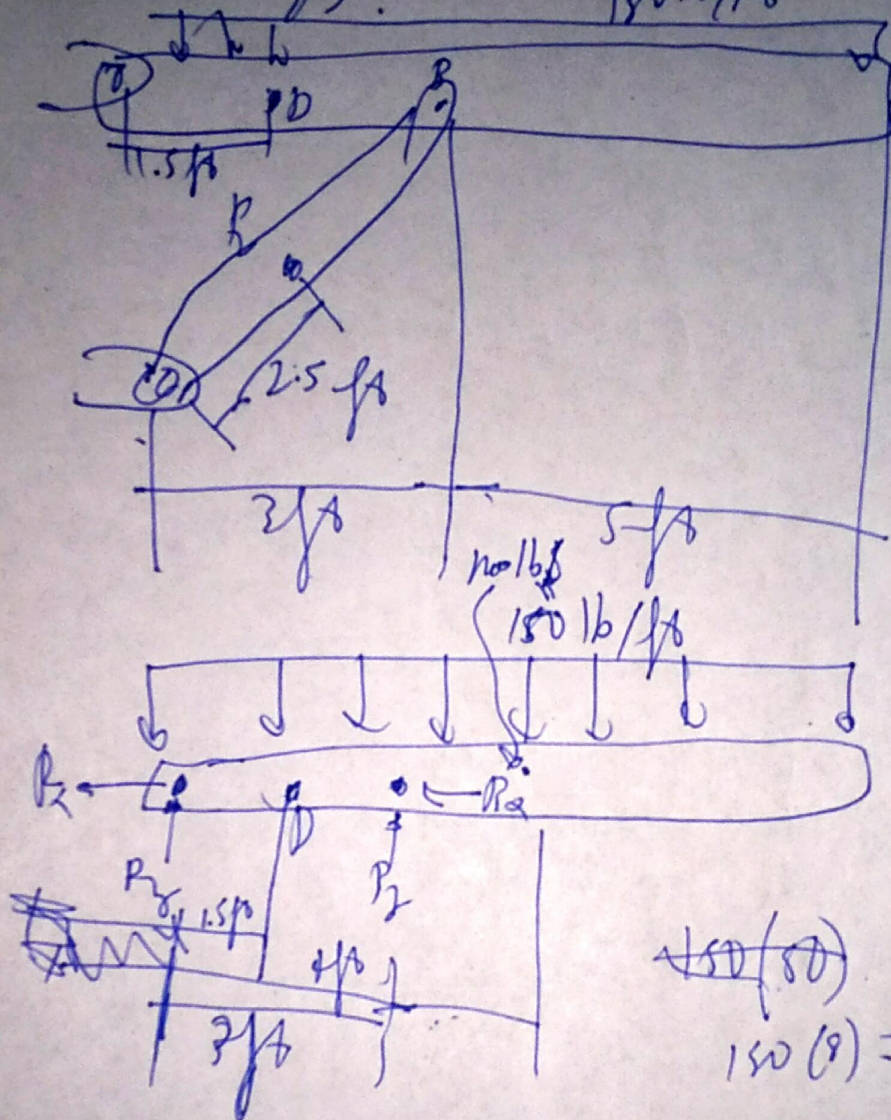
$$J = \frac{\pi}{32} (100^4 - 60^4) = 8.57 \times 10^6 \text{ mm}^4$$

$$b = \frac{I x}{J}$$

$$\theta = \frac{37000 (100) (1000)}{8.57 \times 10^6} = 351.28 \text{ rad}$$

Question 15!

150 lb/ft



$$150(8)$$

$$150(8) = 1200 \text{ lb}$$

$$R_1 = R_2 = 0 : R_3(3) = 1200(4)$$

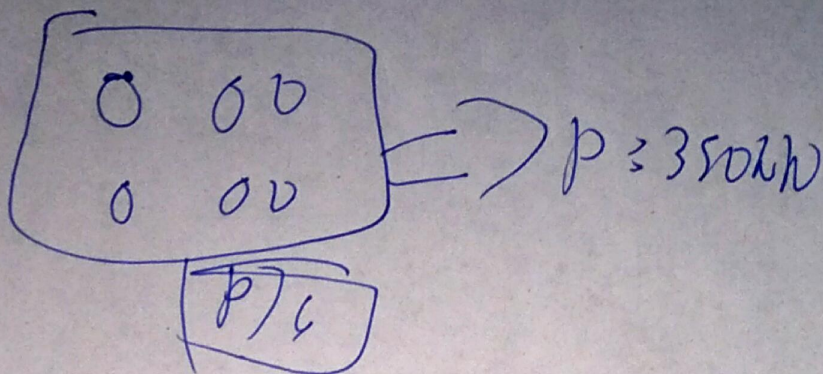
$$R_3 = 1600 \text{ lb}$$

$$R_2 = -400 \text{ lb}$$

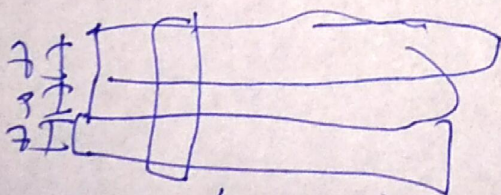
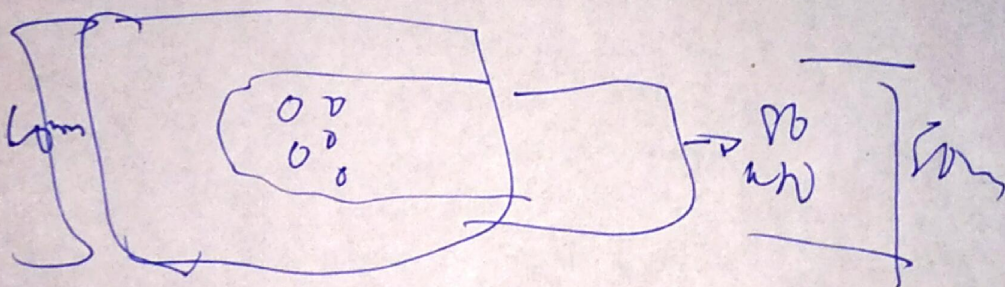
Question 14:

$$A: (2i)(2i) = 4i^2$$

Question 11:



Question 12:



$$t = \frac{(80000/s)}{(7+9+7)(\pi(1))} = \frac{p}{A} = 24.$$

$$t = \frac{80000}{(5)(5(9+7))} =$$

$$t = \frac{(80000/s)}{(5)(\pi(9))} = \boxed{2.88 \text{ MPa}}$$

Question 18,

$$\omega = \frac{8000}{(50)(5)} = 177 \text{ rpm}$$

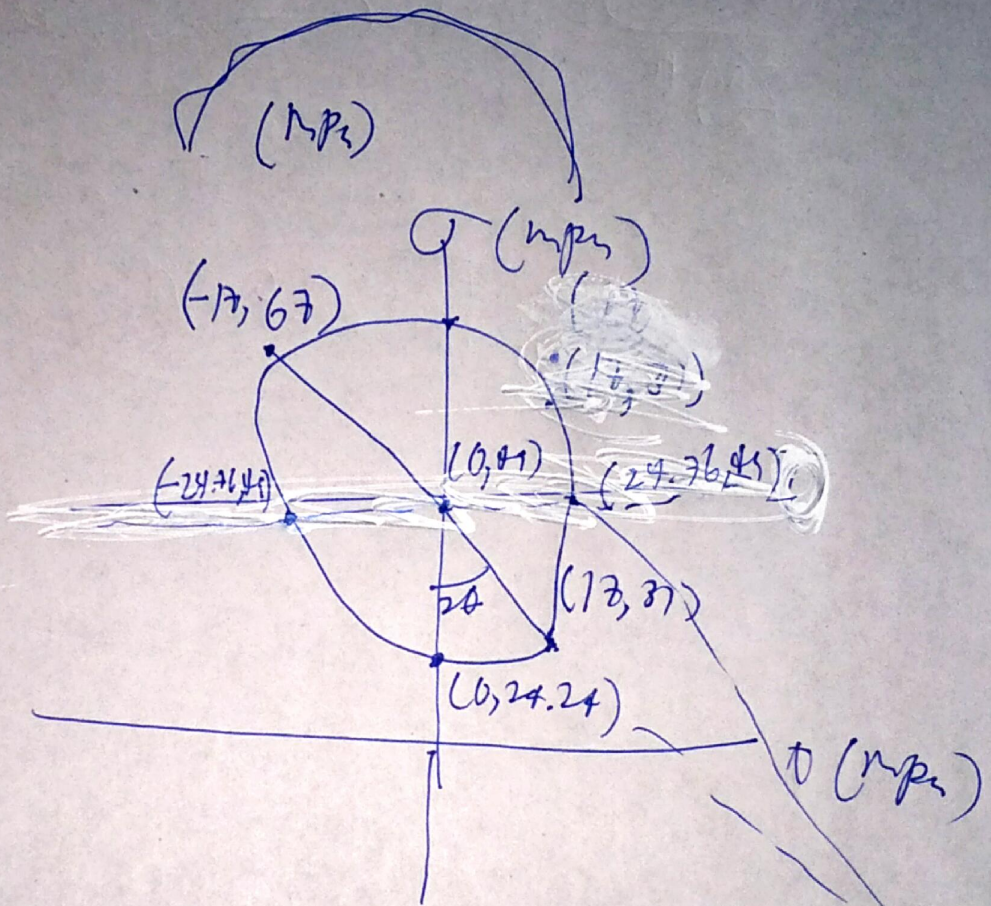
Question 11!

$$t_{max} = \frac{P}{A} \Rightarrow 1200 = \frac{(7500 \text{ N})}{\pi \left(\frac{\phi}{2}\right)^2}$$

$$t_{max} P_s: t_{max} = 1200 \text{ N/m}^2$$

$$\boxed{\phi = 7.88 \text{ mm}}$$

Question 20:



$$2\theta = 47.76^\circ \Rightarrow \theta = 21.68^\circ$$

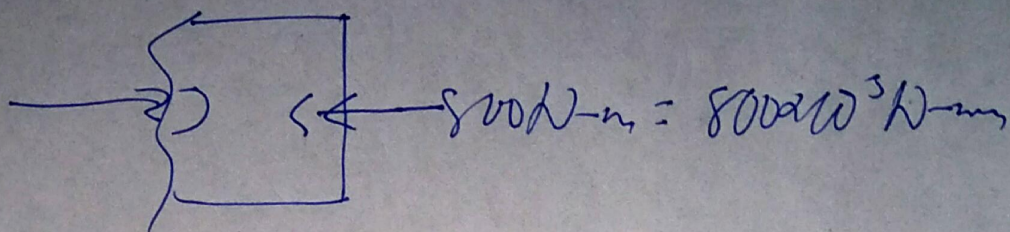
Question 21:

$$\sigma_{\min} = 24.24 \text{ MPa}$$

Question 22:

$$\tau_{\max} = 24.76 \text{ MPa}$$

Question 23!



$$\theta = \frac{TL}{JG} = \frac{800 \times 10^3 \text{ N-mm} (10 \times 10^3 \text{ mm})}{164.896 \times 10^3 \text{ mm}^4 (83 \times 10^3 \text{ N/mm}^2)}$$

$$J = \frac{\pi (18)^4}{2} = 164.896 \times 10^3 \text{ mm}^4$$

$$\theta = 0.58 \text{ rad} = \boxed{33.23^\circ}$$

Question 24!

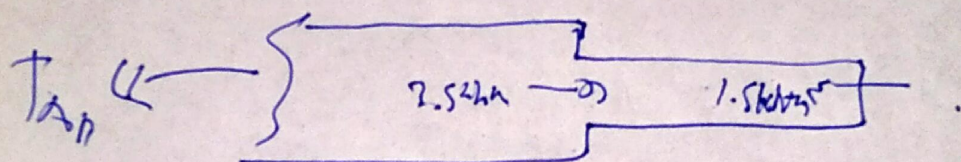
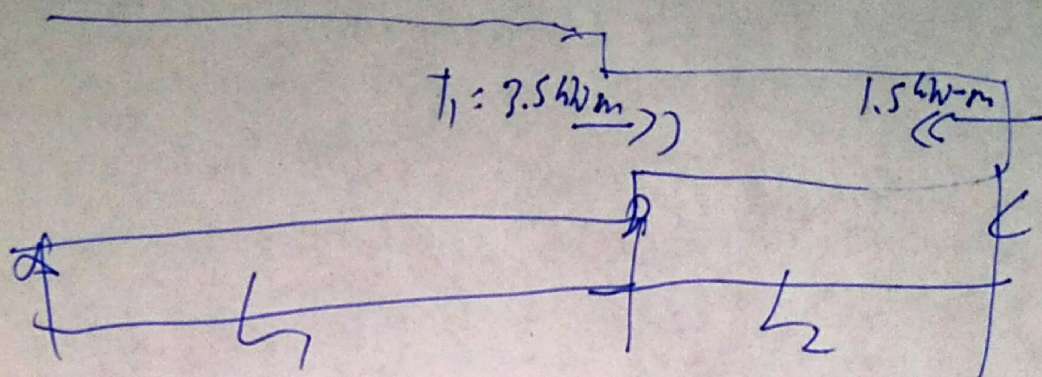
$$J = \frac{\pi (56)^4 - \pi (38)^4}{32} = 760.772 \times 10^3 \text{ mm}^4$$

$$\theta = 3.5^\circ = 0.061 \text{ rad}$$

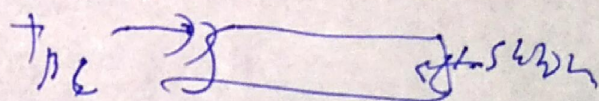
$$0.061 = \frac{800 \times 10^3 (2160)}{762.772 \times 10^3 G}$$

$$G = 34105 \text{ MPa} = \boxed{34.1 \text{ GPa}}$$

Ques 25:



$$T_{AB} = 2 \text{ kNm (T)}$$



$$T_{B2} = 1.5 \text{ kNm (C)}$$

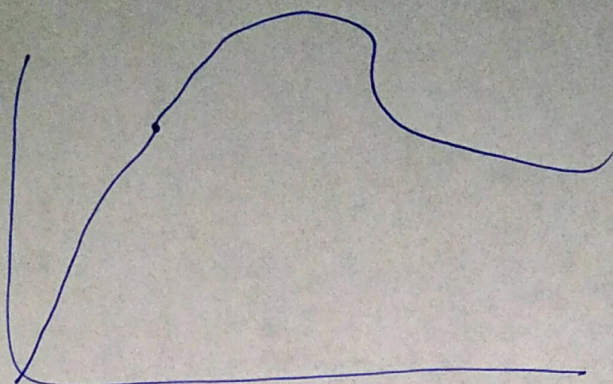
$$\sigma_{AB} = \frac{1056^4}{32} = 965.498 \times 10^6 \text{ m}^4$$

$$\sigma_{B2} = \frac{1052^4}{32} = 212.816 \times 10^6 \text{ m}^4$$

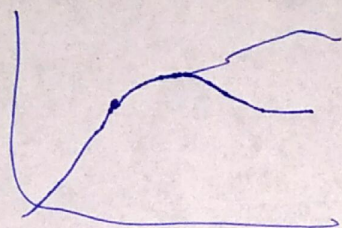
$$T_{AB} = \frac{2 \times 10^6 \left(\frac{86}{2} \right)}{965.498 \times 10^6} = 58 \text{ MPa}$$

$$\sigma_{B2} = \frac{1.5 \times 10^6 \left(\frac{82}{2} \right)}{212.816 \times 10^6} = 54.33 \text{ MPa}$$

Ques 26!



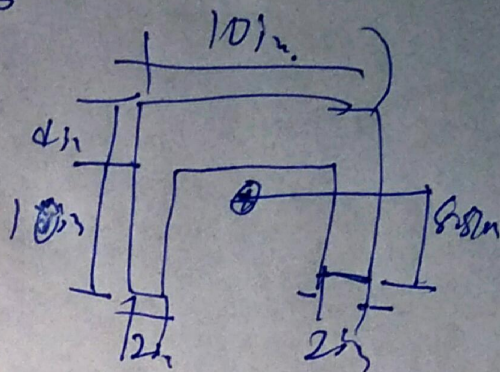
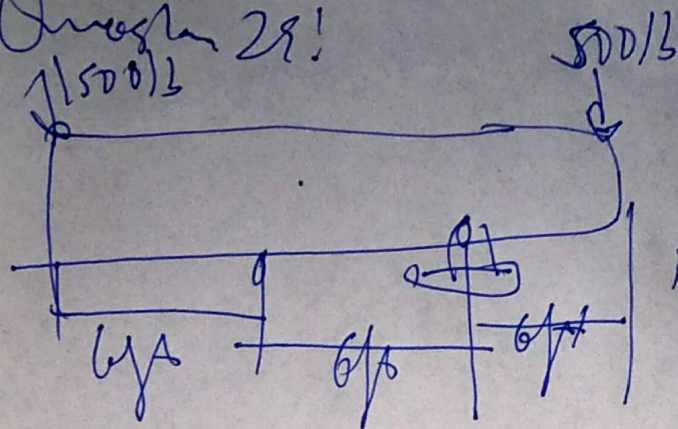
Ques 27!



Ques 28!

$$\sigma = E \epsilon$$

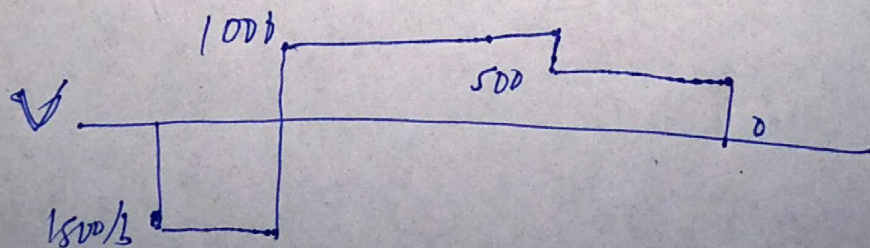
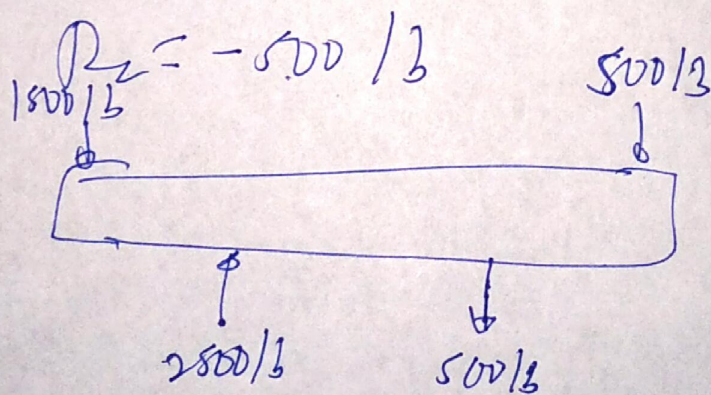
Question 28!



~~$\tau = \frac{VQ}{I}$~~

~~R_B~~

$$M_B = 0: 1500(6) + R_C(6) - 500(12) = 0$$



7h

$$t = \frac{(1500)(110)(4)(1.5+2)}{(1336.67)(10)} \left(\frac{1}{\frac{1}{10}} \right)$$

$$\tau = 188.52 \text{ psi} \quad \tau = 188.52 \text{ psi}$$

7

$$t = \frac{(1500)(2(18.5)(2)(\frac{8.5}{2}))}{(1336.67)(4)}$$

$$t = 40.5 \text{ psi}$$

Question 20!

$$Q = (10(4)(1.5+2)) = 140 \text{ in}^3$$

Quos 31!

Re Quos 29! $\tau = 188.52 \text{ psi}$

Question 32:

$$I = \frac{(200)(240)^3}{12} - \frac{(120)(200)^3}{12}$$

$$I = 117.067 \times 10^6 \text{ mm}^4$$

$$Q = (20)(200)(100) = 440000 \text{ mm}^3$$

$$t = \frac{VQ}{I\bar{y}} = \frac{48000(440000)}{117.067 \times 10^6 (200)}$$

$$t = 0.90 \text{ MPa}$$

Question 33:

For question 32:

$$I = 117.067 \times 10^6 \text{ mm}^4$$

Question 34:

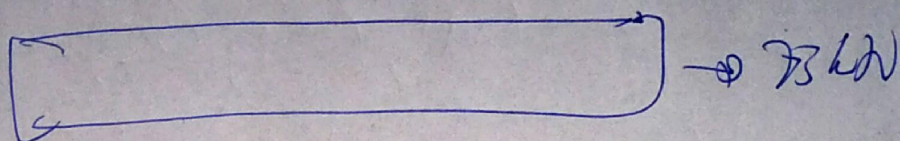
$$Q = (30)(100)(50) + (200)(20)(10) = 530000 \text{ mm}^3$$

$$t = \frac{48000(530000)}{117.067 \times 10^6 (200)} = 8.05 \text{ MPa}$$

Question 35:

$$\phi = 15 \text{ mm}$$

$$\Delta y = -0.0106 \text{ mm}$$



$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{73000}{\pi \left(\frac{15}{2}\right)^2} = 424.41 \text{ MPa}$$

$$\epsilon_y = \frac{\Delta y}{y} = \frac{-0.0106 \text{ mm}}{15 \text{ mm}} = -706.67 \mu\epsilon$$

$$\frac{\sigma}{E} = \epsilon \Rightarrow \frac{424.41}{200 \times 10^3} = 2.122 \times 10^{-3}$$

$$\epsilon = \frac{\Delta x}{x} = -706.67$$

$$\nu = -\frac{\epsilon_y}{\epsilon_x} = \boxed{0.333}$$

Question 36:

$$G = \frac{E}{2(1+\nu)} = 75014.33 \text{ MPa}$$

Question 37:

$$\Delta y = 0.02 \text{ mm}$$

$$\Delta x = -0.3 \text{ mm}$$

$$\epsilon_y = \frac{0.02}{10} = 0.002$$

$$\epsilon_x = -\frac{0.3}{65} = -0.004615$$

$$\nu = -\frac{\epsilon_y}{\epsilon_x} = 0.4$$

$$\sigma = \frac{250000}{(10)(20)} = 1250 \text{ MPa}$$

$$\frac{\sigma}{\epsilon_x} = E \Rightarrow E = 166666 \text{ MPa}$$

$$\sigma = \frac{E}{2(1+\nu)} = 55522.87 \text{ MPa}$$

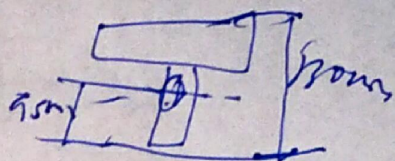
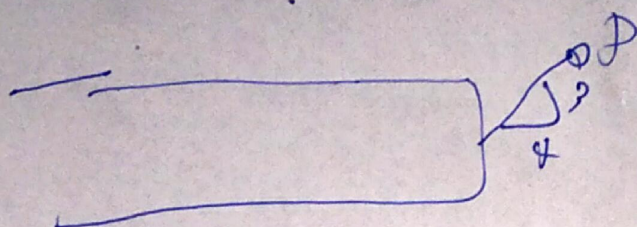
Questions 78!

~~From transfer 374~~

~~$R = 66 \text{ GR}$~~

$$\frac{J}{L_x} = E \Rightarrow \frac{833.33}{4.615 \times 10^{-3}} = 180.576 \text{ kN}$$

Oregon 251



$$I = 7.85 \times 10^4 \text{ Nm}^2$$

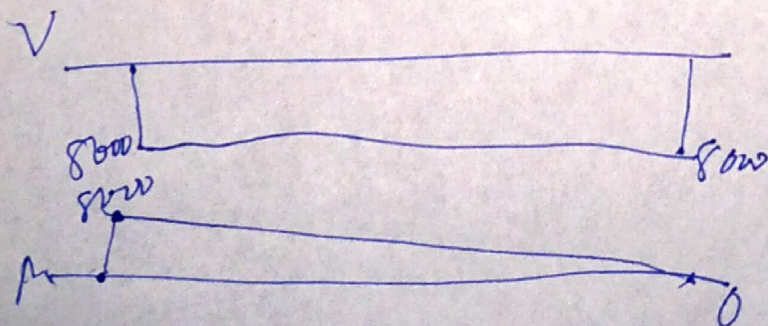
$$A = 6500 \text{ m}^2$$

$$P_2 = 8 \text{ kN}$$

$\phi_y = 6 \text{ rad}$

$$\sigma_w = \frac{8600}{6500} = 1.23^{NR}(T)$$

+ ~~1500~~ 1500 ⁵⁰⁰ 500



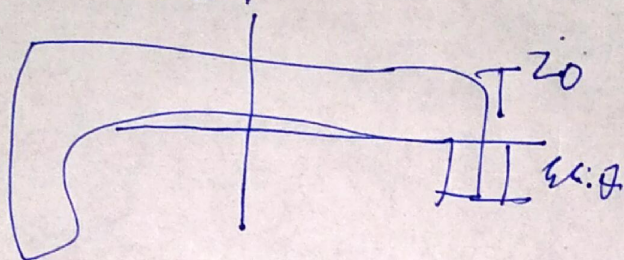
Question 40:

$$\sigma_b = \frac{M_z}{I} = \frac{(8 \times 10^6) (55)}{7.85 \times 10^6} = 98.84 \text{ MPa}$$

Question 41:

$$\sigma_b = \frac{M_z}{I} = \frac{(8 \times 10^6) (55)}{7.85 \times 10^6} = 98.84 \text{ MPa}$$

Question 42:



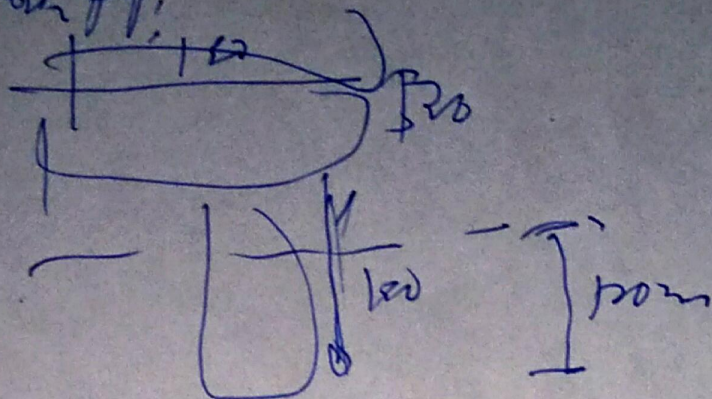
$$I_2 = 3.33 \times 10^6 \text{ mm}^4$$

Question 43:

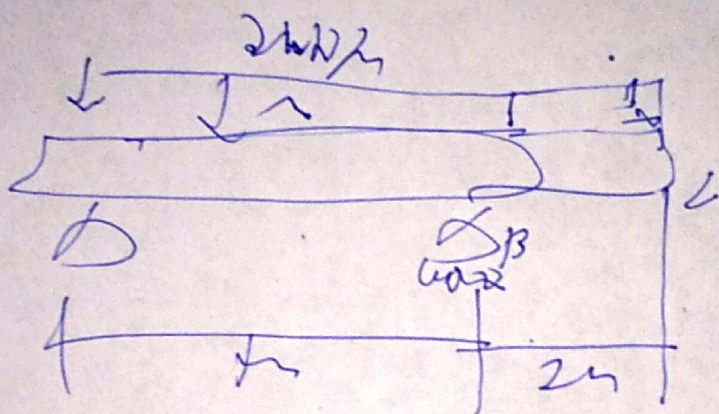
$$F = 5 \text{ kN}$$

$$\sigma_b = \frac{(5000) (50)}{I}$$

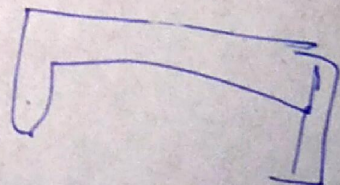
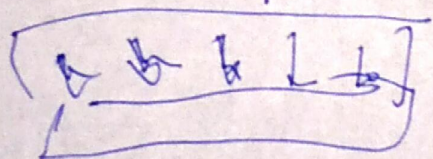
Question 99:



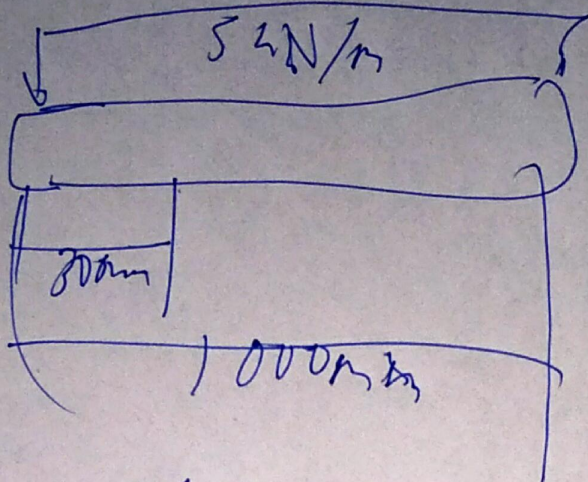
Question 95:



Question 96:



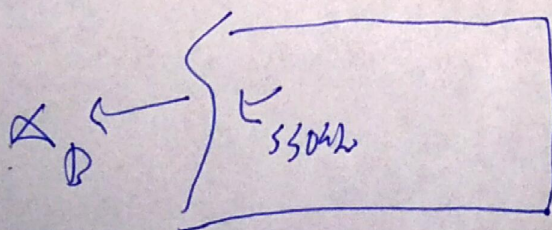
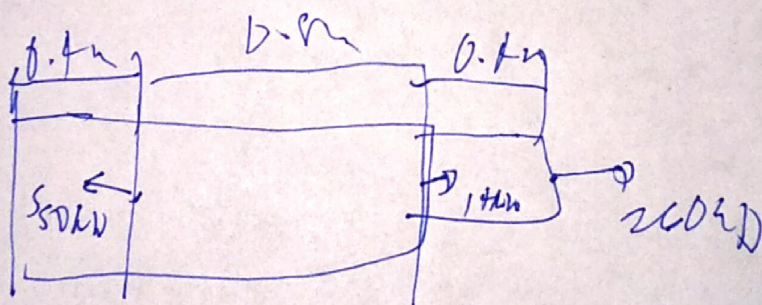
Ques for 47!



$$5 \left(\frac{2}{10} \right) = 1.5 \text{ kN}$$

$$5 \left(\frac{7}{10} \right) = 3.5 \text{ kN}$$

Question 48:



$$P_{AB} = 150 \text{ kN (C)}$$

$$P_{AC} = 400 \text{ kN (T)}$$

$$P_{CD} = 260 \text{ kN (C)}$$

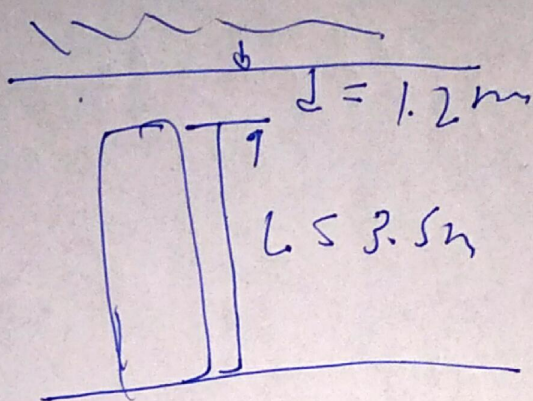
$$\delta = \frac{PL}{AE}$$

$$\delta = 1.27 \text{ m}$$

Question 45

$$\frac{400\,000}{2\,600} = 133.33 \text{ N/mm}^2$$

Question 50



$$\alpha = 13 \times 10^{-6} / ^\circ\text{C} \quad \text{Rs } 2056 \text{ kg}$$

$$\delta = \alpha \Delta T L$$

~~1.25~~

$$1.25 \alpha \Delta T L \Rightarrow \Delta T = 26.37 ^\circ\text{C}$$

Question 57:

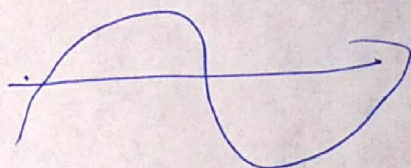
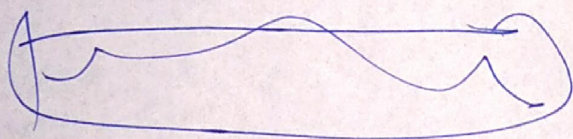
$$\Delta T = 50^\circ\text{C} - 26.33^\circ\text{C} = 23.67^\circ\text{C}$$

$$0 = \frac{\sigma L}{E} + \alpha \Delta T L$$

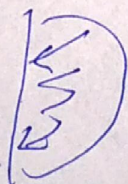
$$0 = \sigma \frac{L}{E} + \alpha \Delta T L$$

$$\sigma = 6.247 \text{ MPa} \quad \sigma = 62.47 \text{ MPa}$$

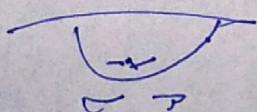
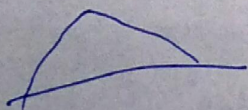
Cons in 52:



Contrib 53:



Cons in 57:



Answer 53:

$$\sigma_{avg} = \frac{PD}{4b} \rightarrow \sigma_{ext} = \frac{PD}{2b}$$